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EPA's view of the oxidant problem in Houston

Basil Dimitriades

EPA's view of the oxidant problem in Houston

Control of ozone, not as a surrogate for oxidants but as the component most responsible for health problems associated with photochemical oxidants, may warrant replacing the oxidant NAAQS with an ozone NAAQS

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The Environmental Protection Agency's (EPA's) interest in the Houston oxidant problem dates back to the early 1970's when members of the scientific community and governmental agencies in Texas alerted the agency to the possibility that the nature and composition of the organic emissions, and the ratio of hydrocarbon to oxides of nitrogen in the Houston area might be considerably different from those with which nearly all past research was concerned. That is, the oxidant-precursor and ozone-precursor relations derived from past research might not be applicable to Houston.

A new study

Consistent with the responsibility entrusted to EPA under the Clean Air Act Amendments of 1977, the agency will begin a research program this fall to elucidate the nature of the air pollution problems in the Gulf Coast area. The first phase of the program will be conducted in the Houston area and will include a study of the chemistry, physics, and health aspects of the ambient aerosol problem, as well as certain aspects of the ozone problem.

EPA is working with the Gulf Coast Air Pollution Research Committee in the design of the Houston study. To the extent that resources are available, the ozone effort will include modeling and statistical studies of the emissions-to-ozone relationship and of the relative influence of natural sources of ozone.

This new research effort was initiated in part because EPA's oxidant control strategy, based on control of organic emissions, was criticized as being inappropriate for Houston. Texas investigators reported that they could see no evidence of significant improvement in Houston's oxidant

problem despite substantial control of organic emissions in that area.

A number of Texas air pollution officials have expressed the viewpoint that the health effects of Houston's photochemical air pollution are not caused by oxidants—especially ozone. (Ozone is the principal constituent of the class of compounds that contribute to EPA's oxidant index.)

EPA's understanding of the Texas officials' viewpoint is that they believe that ozone is not the pollutant re-

Assertions in support of the Texas viewpoint appear to be based on one or more of the following arguments:

- There is no convincing evidence that the health effects caused by ozone justify the national ambient air quality standard (NAAQS) for ozone.
- Ozone does not seem to correlate with eye irritation and haze in Houston.
- There is a preponderance of unusual organic emissions from the Houston ship-channel activities.



Houston skyline. The photograph taken from an expressway (left) shows the downtown sky-

sponsible for the health effects attributed to photochemical oxidants, and ozone is not an appropriate surrogate for such oxidants.

The Texas investigators suggest that the species responsible for whatever air-pollution-related health effects occur in Houston are oxidants other than ozone and other photochemically generated products. The exact nature of these other products has not yet been specified to EPA. Aerosols, aldehydes, and peroxyacyl nitrates have been mentioned as candidates, but little evidence has been reported so far to support their contribution to the oxidant problem.

- Meteorology in Houston is unusual in some respects (high humidity).

Sources of information

The EPA viewpoint on the Houston oxidant problem is based on research evidence. Some of this evidence has been obtained from field studies in Houston, but the majority of relevant research results comes from laboratory or field studies outside of Houston. The results from laboratory and field studies outside Houston can be found in EPA reports and criteria documents, and in National Academy of Sciences reports. The studies con-

ducted in the past in the Houston area are less well known because most of the results don't appear in the scientific literature.

From EPA's Houston studies, it was established that man-caused ozone was clearly the major factor in the high-ozone episodes in Texas. The preponderance of available evidence appears to support the tentative conclusion that natural sources do not contribute significantly to the oxidant problem in the Texas Gulf Coast area. However, the evidence is admittedly indirect and, in some respects, insufficient.

Ozone and health effects

According to EPA, ozone is responsible for a large portion of the health problems associated with photochemical oxidants, and that the effects of ozone, at a given concentration, should not be greatly different in Houston than anywhere else. Further, in the matter of health effects, EPA does not view ozone as a surrogate for other species that contribute collectively to the oxidant index.



red by photochemical smog; the photograph on the right shows Houston on a clear day

The use of ozone as a surrogate for oxidants evolved from EPA's first efforts to develop a control strategy for photochemical pollution. At that time, the adverse health effects observed in polluted atmospheres—mainly in Los Angeles—could not be attributed to specific pollutant species, although there was some evidence that implicated ozone and other oxidizing pollutants. For this and other reasons, ozone was proposed as a surrogate for photochemical oxidants.

The surrogate concept

Among the other reasons for using ozone as a surrogate were the facts

that ozone and the other oxidants are all products of the same reaction process involving HC and NO_x as reactants; that ozone is by far the major single photochemical oxidant species; and that, relative to other photochemical pollutants, it can be measured accurately. From a control standpoint, the most important reason was thought to be the first one: the control of ozone should be accompanied by reduction in other oxidants.

This surrogate concept, and its suggested use in control is no longer accepted by EPA. The agency now feels that there is sufficient evidence to implicate ozone directly as the pollutant responsible for adverse health effects; therefore, EPA is considering replacing the National Ambient Air Quality Standard (NAAQS) for oxidant with a NAAQS for ozone. EPA maintains that ozone can be best controlled by controlling emissions of reactive organics, which are its primary precursors.

The EPA position on quantitative ozone-to-haze and ozone-to-eye-irri-

tation relationships is that these may indeed be different in Houston, Los Angeles or any other urban area. However, the agency does not view ozone concentration as a quantitative surrogate for these manifestations of photochemical smog. EPA does expect reductions in ozone (via HC and NO_x emission controls) to be accompanied by reductions in other photochemical pollutants, but does not believe that measures adopted for ozone reductions are necessarily the optimum ones for controlling other pollutants.

If optimum control strategies are to be developed for pollutants such as aerosols, and peroxyacyl nitrates, then

new pollutant-specific studies will have to be conducted, and new pollutant-specific strategies will have to be developed. However, on the basis of EPA's assessment of the situation, control strategies aimed at ozone reduction attack the highest priority health-effects problem.

Support for control strategy

EPA believes that a number of documented chamber studies, field studies and scientific theories support fully the agency's national control strategy for ozone oxidant. There are several aspects of the ozone-oxidant phenomenon in the Houston area that suggest consistency with those found in other areas of the country.

Though the claim has been made repeatedly that a very large reduction (40%) of reactive HC emissions has been achieved in the last three years in Houston, the degree of organic emission reduction achieved is highly uncertain. The presence of uncontrolled, uninventoried emissions resulting from leaks, malfunctions or deterioration of control devices are factors that are certain to cause incorrect estimates of emission reduction, as are estimates of HC emissions from the diverse sources in Houston with its rapidly expanding population.

An equally serious problem in estimating the impact of emission reduction on oxidant-related air quality is the fact that the abundance of data needed to quantitatively separate the effects of emission reductions from the effects of changes in meteorology is neither available nor easy to acquire.

A 40% reduction in reactive HC in any area may yield substantially smaller reductions in peak annual ambient ozone. Since meteorology variations alone can cause a $\pm 20\%$ year-to-year variation in maximum annual oxidant, it seems reasonable to assume that a reduction in ozone in Houston could be very difficult to detect with only three or four years of data. Reductions in annual peak hourly average ozone concentrations of the order of concern here can only be observed over long periods of time.



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